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REPORT

UPON

FORESTRY.

PREPARED

UNDER THE DIRECTION OF THE COMMISSIONER OF AGRICULTURE, IN PURSUANCE OF AN ACT OF CONGRESS APPROVED AUGUST 15, 1876.

BY

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DAKOTA TERRITORY.

This region, in its general characteristics, resembles the adjoining parts of Minnesota and Nebraska, being naturally a treeless country except along the rivers and streams. The hilly and broken region of the western part is thinly timbered in the valleys.

SULLY COUNTY.—*Fort Sully.*—This post is about 2,000 feet above sea level, and 200 above the Missouri River, being on the *second bench*; a third one about 100 feet higher being of the general level of the country, which is gently rolling, and cut with beds or streams of water, or the dry channels of the same. The soil is alkaline throughout this entire region. This is what was formerly regarded as the "dry belt," but there appears to have been a change in the rain-fall. In 1873 it was 14.62 inches; in 1874, 16.24; in 1875, 14; and in 1876 (less April), 17.26; in the first seven months of 1877, 17.17 inches.[1] The summer climate is quite warm, 98° in the shade having been noticed almost daily for two months in 1874, and on one occasion, 112°. But since that year the weather has not been so hot, and there has been now and then a cool day in summer, and always cool mornings and evenings. The buffalo-grass now retains its green longer, and grows longer, than was noticed three years ago.

The only trees in the country are on river-bottoms, and in narrow strips along the creeks and ravines. The cottonwood is the only timber-tree. Red cedar is found of considerable size, generally in the ravines, where the dwarf-plum is also plentiful. Wild grapes, and a wild fruit called Buffalo or bull berry are also found. The willow, kinnikinic, wild rose, and sweet briar are also abundant on the bottoms, and the hackberry, wild cherry, and white and scrub oaks are also occasionally found.

In 1875 about 80 trees were planted by Maj. H. M. Lazelle, First Infantry, around the sides of the parade-ground (but at some distance from the buildings), and about 30 or 40 more around the officers' quarters and laundresses' quarters. These trees were watered regularly. Those near the officers' quarters have all lived, and done almost as well as if left on the river-bottoms, while those around the parade-ground, with the exception of about half a dozen, died, and were replaced by others in the spring of 1876. These latter appear to have a struggle for existence, and about 15 have recently died. I think it a fair conclusion that the partial shading from the sun has something to do with the better growth of those near the quarters. It is noticed that while for the first two or three years the growth of those entirely without shade was almost imperceptible, at the end of that period they appeared to take a sudden start and grew rapidly.

The climate of this post is exceedingly cold in winter (sometimes —40°). It occasionally thaws, and in case there should be several inches of snow on the ground it disappears without being followed by mud or even wet. It appears to evaporate rather than melt.

The Missouri River is constantly changing its bed from side to side of its narrow valley. As it cuts away the bank on one side, it shoals on the other, until, in the course of time, the bottom reaches high-water mark, when a dense growth of willows commences. At the lowest stage of the river sand-bars appear in great numbers occupying the greater part of the bed of the stream. When these become dry, the wind raises clouds of dust, which further elevates the newly made land, and the willows are in time replaced by a growth of cottonwoods.—(*Thomas Sharp, 1st Lieut., First Infantry, United States Army.*)

NEW MEXICO TERRITORY.

Professor Hayden, in his report of 1871 (p. 223), says:

New Mexico presents a very large treeless area. Around the sources of the Pecos, along the eastern and southern rim of San Luis Valley, on the Mimbres and Guadalupe Mountains, and in the northwestern part of the Territory are found the principal forests affording valuable timber, while the rest of its area is generally without forests or trees of any value except for fuel. Fortunately the forests are generally in the vicinity of the narrow agricultural areas, and in some instances the trees are large and fine, making good lumber; but most of the older towns and villages have to procure their lumber and fuel at a considerable distance.

DONA ANA COUNTY.—The valley of the Rio Grande, running through this county, where not cultivated, is covered with a growth of cottonwood, making very fair fire-

[1] It is since learned that 1869, 1870, and 1871 were wet years. It is quite probable that the amount varies considerably in different years, and until a long series of records have accumulated, we cannot with confidence conclude that there is any permanent change.

wood. The logs are used for joists, on which the earth used for roofing is placed. The foot-hills, immediately adjoining the river-bottoms, are covered with mesquite timber, a kind of shrub with enormous clusters of roots, which are dug out and used as fuel. They make an intense heat, and are almost equal to coal. They also make excellent charcoal for forge use. On the mountains, in various parts of the county, are small quantities of pine, oak, juniper, cedar, ash, hackberry, walnut, and mulberry, generally scrubby, and the pine alone of sufficient size for sawing into lumber. It makes very fair lumber for finishing. The ash is of good quality for wagon-making. A considerable amount of this timber lies along the bed of the Rio Grande, brought down by the current. It grows rapidly, and is really a valuable timber, being tough and strong. It is being cultivated to a limited extent. Within the last four years the Osage orange has been introduced for hedges and is found to grow thriftily. This and the ash, if set out along public roads and boundary lines, would, in a few years, supply a great want in furnishing wood for various uses. The Eucalyptus is also being introduced, as well as the Monterey cypress, but the result is not yet determined.—(*T. Casad*, Mesilla, Dona Ana County, New Mexico.)

SANTA FÉ COUNTY.—In most of the cañons and gorges of New Mexico, timber large and excellent, principally pine, is found in great quantity. The report of the 35th parallel railroad route through New Mexico refers to the supply of timber to be found along the proposed railway line. From the most reliable data within reach we estimate that in New Mexico there are 5,000,000 acres of timber land, including all lands not destitute of trees. The principal trees found in the mountain valleys of New Mexico are the ash, walnut, and hackberry, and on the mountains pine, oak, cedar, piñoreal, and piñon. The principal tree of the deep valleys and stream-margins is the cottonwood, a brash tree, which will not make lumber, but it is a beautiful shade tree, found transplanted around residences, and which answers most of the requirements for building and fencing.—(*T. M. Sesay Baia*, Santa Fé, N. Mex., quoting from Brevoort's *New Mexico, Her Natural Resources and Attractions*, 1874.)

COLORADO.

The waste of timber by the early miners and settlers in Colorado was extremely reckless and improvident. Mr. Raymond, in his second report of Statistics of Mines and Mining (1870), in speaking from his own observation and statements furnished by Mr. Wm. N. Byers, of Denver, says:

When the Territory was settled, some ten years ago, the mountain-sides were found covered with thick forests of pine, spruce, fir, and other trees, most of them of small size and short body. A given space would not give a large quantity of lumber or wood, as compared with many timbered countries, but for that reason it was more valuable, and economy of more importance, because there was no other source of supply. Generally these forests were green and flourishing. Only at rare intervals could a tract be found that had been burned over by the Indians and the trees killed. To-day, certainly one-third, possibly one-half, in all the settled portions of the Territory are dead—killed by fire. And outside the settlements, in regions visited at long intervals only by prospectors, their tracks can be everywhere seen in blackened trunks and lifeless, desolate-looking hill-sides. During the dry, scorching latter summer, the eye seldom glances over the mountain landscape without seeing somewhere—often in several places—the dense column of smoke that indicates a burning forest. Some of this destruction is fairly attributable to accident, more of it to culpable carelessness, and yet more to criminal design.

Another source of timber waste is in the felling of trees unnecessarily. Often a man, finding a good body of timber for lumber, will go to work and slash down hundreds or thousands of trees, thinking that some other man will come in with a saw-mill and buy his logs. Sometimes the customer makes his appearance, but often he does not until the logs are rendered nearly or entirely worthless by decay and the ravages by worms. But even if the saw-mill comes, there is no effort at economy. Timber is plenty; it belongs to the United States, and the pioneer has as good a right to it as any one else. Hence only the best is used. The tree that would furnish three saw-logs and the top two cords of wood, if it belonged to the logger or mill man, in this case supplies but two logs, and the remainder is left to rot or to be devoured by the fire that is set when the neighborhood has been skinned of its most valuable trees. The saw-mill is pulled up and moved a mile, or five, or ten, to another fine grove, where the same thing is done over again, and so on. At Central City, the oldest and most populous gold-mining center of Colorado, the consumption of wood for fuel is very large. A few years ago it was purchased for $2 per cord, but the increased distance of hauling has advanced the price about one dollar each year, until now it frequently costs $10. Lumber has to be brought from 20 to 40 miles, and heavy mill timbers often much farther. And, to obtain these articles, they are robbing and skinning districts that may at any day require their own timber, just as much as Central City

ever did. Denver, which formerly obtained her supplies of lumber within twenty or thirty miles, now has to haul much of it sixty. Other examples might be cited, but it would only be an accumulation of evidence.

Professor Hayden, in speaking of the resources of Wyoming Territory, in his report of 1871 (p. 224), says:[1]

The principal timbered sections of Wyoming are those along the southern boundary of the Territory and in the extreme northwestern corner; large tracts of country, even within the mountain districts, as Laramie Plains, the Green River Plains, and Sweetwater country being almost entirely timberless.

Mr. Henry Gannett, in reporting to Professor Hayden the geography of a division between parallels of latitude 38° 45′ and 39° 30′, and between the 8th guide-meridian of the land-survey on the east, and by the 107th meridian on the west, makes the following statements concerning the timber:

The plains forming the eastern part has no timber, except on the summit of the divide. The Colorado or Front Range, a plateau region rising abruptly from the plains, is sparsely timbered with pine and spruce. Between Tarryall Creek and the South Platte, the country is open, park-like, and well watered, as also is most of the country lying south of the South Platte. There is plenty of the best timber and grass. There is no timber in South Park except on the sides, but in the mountains there is an abundance of the best timber. West of the Park Range is the valley of the headwaters of the Arkansas River, 5 to 10 miles wide, well watered, and sparsely timbered. Eagle River heads opposite the head of the Arkansas, in Tennessee Pass, and flows northwest to the Grand River. There is an abundance of timber in the hills. The vegetation of the mountain valleys, drained by the Gunnison River and Roaring Fork, have a rich soil, derived from limestone and sandstone, with pine and spruce trees covering the ridges heavily, while the bottoms are choked by quaking aspen trees.

Mr. Gannett, in his botanical notes, mentions as among the trees affording timber, the *Populus balsamifera* var. *candicans*, the cottonwood occurring at middle elevation, and the only poplar that could be used as timber; *Pinus ponderosa*, the yellow pine, growing 70 to 100 feet high, and common on the lower slopes, a most useful timber tree; *Pinus flexilis*, on the divide between South Park and the Arkansas Valley; *Pinus edulis*, the piñon pine, near Colorado Springs and Twin Lakes, and *Abies Engelmanni*, the white pine, growing 60 to 100 feet high, wood closely allied to the black spruce of the east, and found on the mountain slopes of the Elk and Sawatch ranges.

The timber line was found as follows:

	Feet.
Pike's Peak, east face	11,721
Mount Guyot, north face	11,811
Mount Silverheels, northeast face	11,549
Mount Lincoln, east face	12,051
At head of Buckskin Gulch, south face	11,587
Station 52, Park Range, east face	11,663
Station 56, Park Range, east face	11,759
Park range, Mosquito Trail, west face	11,656
Park range, Mosquito Trail, east face	11,656
Station 40, near Mount Evans, south face	11,559
Buffalo Peak, northwest face	12,041
Sawatch Range, head of Frying-pan Creek, west face	11,583
Massive Mountain, north face	11,607
Mount Elbert, east face	11,871
La Plata, east face	12,080
Grizzly Peak, south face	11,758
Mount Harvard, east face	12,117
Station 89, near Mount Princeton	11,514
Station 63, Elk Mountains, east face	11,513
White Rock Mountains, south face	11,919
Station 68, Elk Mountains	11,686
Station 82 on ridge north of Frying-pan Creek	11,830
Station 75, near head of Texas Creek	11,574
Mean elevation of timber line	11,694

[1] Report, 1873, p. 671.

Mr. S. B. Ladd, in reporting to Professor Hayden[1] upon the topography of the Middle Park division, embraced between latitude 39° 30′ and 40° 20′, and between longitude 104° 45′ and the Park range, which forms the western boundary of the Middle Park, mentions—

The ridges and mountains as well timbered, mostly with yellow and white pine (*Pinus ponderosa* and *Abies Engelmanni*), and the parks and valleys as bearing a fine growth of scattered timber. In the vicinity of the mining towns a great deal of timber had been cut, and in places over large districts it had been destroyed by fire. An area of 1,200 square miles was timber-bearing, and the remainder either above timber-line, or else taken up in the open valleys and parks. The western division, including the Middle Park, drained by the Grand River and its tributaries, was well timbered on the spurs thrown out from the main range, especially in the eastern half of this section. The hills formed by the metamorphic rock grew timber, mostly white pine, although on the western slopes it is smaller than on the eastern. The amount of this granite timber area is about 675 square miles. The lignite areas, which comprise a large portion of the park, are essentially timbered, but the quality is very inferior to that growing on the metamorphic rocks, and the southern slopes are generally bare. Over large areas the timber has fallen, making it often difficult to travel away from the trails. This class of timber land might be estimated at 425 square miles. The regions covered by the lake-beds are, as a rule, totally destitute of timber. The areas covered by Cretacious No. 1 bear timber, while the remainder of this formation, occupying the lower valleys and partially covered by the lake-beds, does not represent a timber country. This is illustrated in the valley of the Blue, where the timber growth follows the outcrop of Cretacious No. 1 across the valley. This class covers about 150 square miles of country. The hills capped with lava, grow timber. All told, there are about 1,250 square miles of timber land in this western subdivision.

The timber-line is reported within the boundary of this exploration as follows:

	Aspect.	Approximate latitude.	Elevation.		Aspect.	Approximate latitude.	Elevation.
		Deg. Min.	*Feet.*			*Deg. Min.*	*Feet.*
Mount Evans	E.	39 35	11,300	Bald Mountain	E.	40 00	11,100
Gray's Peak	N.	39 40	11,100	Long's Peak	E.	40 15	11,100
Mount Powell	N.	39 45	[2]11,600	Mount Lillie	....	40 15	11,100
Mount Byers	S.	39 50	11,400	Station LX	S.	40 20	[2]11,000
James's Peak	E.	39 50	11,100	Park View	E.	40 20	[2]11,100
Arapahoe Peak	S.	40 00	11,100				

Some very successful examples of evergreen planting may be seen in Denver and its suburbs. The plants are taken from the mountains, being carefully lifted by spades, and laid upon coarse canvas, which is then bound firmly around the ball, and the trees are taken to the place where they are to grow. The auspicious time for this operation is just after the new growth has started, and while the functions of life are most active. This at Denver occurs about the early part of June. The plant should be abundantly watered as the roots are adapting themselves to their new conditions.

The lumber business of Denver in recent years has been as follows:

1872. Planing-mill products	$115,000	Lumber trade	$950,000
1873. Planing-mill products	256,000	Lumber trade	809,000
1875. Planing-mill products	305,000	Sash, doors, and blinds	275,000
General lumber business	320,000		
1876. Lumber, sash, and doors	578,000	Wood manufactures	95,000

Arapahoe County.—The trees commonly cultivated about Denver are the cottonwood (3 varieties) and box-elder that are native, and silver maple, white ash, elm, and honey and black locusts that are introduced. The mountain ash and sugar-maple fail. The willow and cottonwoods come in of themselves in some places, without irrigation, where stock is kept out.—(*Wilson Perrin*, Denver, Colo.)

[1] *Geological and Geographical Survey of Colorado*, 1873, p. 661.

[2] Estimated.

WYOMING TERRITORY.

In the report upon the reconnaissance of Northwestern Wyoming and the Yellowstone National Park, in 1873, by Capt. William A. Jones, U. S. A., it is estimated that the timber of this region covers 2,000,000 acres,[1] the presence of which indicates a somewhat equitable amount of rain-fall, doubtless sufficient for cultivation without irrigation, so far as its great elevation and summer frosts may admit.

Hilliards, near the southwestern corner of this Territory, and on the line of the Union Pacific Railroad, is a point of some importance in the production of wood for charcoal and railroad ties. It is brought in a V-shaped flume about twenty-eight miles from the United Mountain region, where the supplies, although difficult of access, are said to be somewhat abundant. This flume will carry logs 30 inches in diameter and 20 feet long, and will deliver 150 to 200 cords in twelve hours.

Albany County.—The Laramie Plains are some 7,000 feet above sea-level, about 100 miles long and 30 broad, with the Black Hills of Wyoming to the east and the Medicine Bow range to the west. Rain-fall, 17.97 inches in 1872; 13.14 in 1873; 10.86 in 1874; 11.97 in 1875; and 10.97 in 1876. The soil is good, but liable to frost in every month, unless, perhaps, July. The native trees in the mountain gorges are pine, and on the water-courses cottonwoods and aspens. A few trees at Fort Saunders, planted along a ditch (aspens and cottonwoods), are apparently healthy, but they would probably die if the water was cut off. About half a million of pine ties are used annually in replacing ties along the Union Pacific Railroad.—(*A. G. Brackett*, Fort Saunders, Wyo.)

MONTANA TERRITORY.

In an article[2] upon the sylva of Montana, Dr. J. G. Cooper enumerates the following species as growing within the Territory:

Rhus glabra (Smooth Sumac). No species found above Fort Union, and one found on the Columbia plain north of Fort Colville may be distinct.

Negundo aceroides (Box-Elder). Reaches Fort Benton but does not pass the mountains.

Acer glabrum (Smooth Maple). From east base of Rocky Mountains to the Cascade Range, becoming 40 feet high and a foot in diameter.

Cerasus Virginiana? (Choke Cherry). Across the mountains to the Bitter Root Range, growing 20 feet high and 6 inches in diameter.

Cerasus mollis? A shrub at Cœur d'Alêne Mission and westward taken to be this. It had a stunted growth.

Pyrus fraxinifolia vel *Americana?* (Western Mountain Ash). First appear on east slope of Cœur d'Alêne Range, scarcely a tree.

Crataegus rivularis (River Hawthorn). From east base of Rocky Mountains to Cascade Range, growing 15 to 20 feet high. Finest along the Spokan River.

Crataegus sanguinea? (Red Hawthorn). Sparingly from Walla Walla to Fort Colville.

Frangula Purshiana (Oregon Bearwood). Both slopes of Cœur d'Alêne Mountains, but not farther east. A bushy *Rhamnus* is found with it.

Amelanchier alnifolia (Oregon Service-Berry). From east base of Rocky Mountains to Pacific coast.

Cornus pubescens (Green Dogwood). Seen near crossing of Bitter Root River, and at intervals to the coast.

Celtis reticulata (Western Sugar-Berry). Strictly limited toward northwest by Snake and Columbia Rivers, as observed in 1853.

Quercus Garryana (Oregon Oak). Not east of east base of Cascade Range, or north of Yakima River. No oak occurs from the Columbia River to Fort Union, on the Missouri, where the *Q. macrocarpa* (Burr Oak) occurs. No ash grows to a similar interval, though one extends to Milk River on the Missouri.

Fraxinus Oregona (Oregon Ash). First appears at the Dalles.

Betula occidentalis (Western Pogue-Birch). A shrubby tree from Sun River through the Rocky Mountains to Cœur d'Alêne Range, where it becomes of large size, 60 feet high and 2 in diameter.

Alnus viridis? (Green Alder). Perhaps a new species, or *A. rubra*. Range similar to western birch, and of greater size to the west.

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[1] Report, p. 58.

[2] *American Naturalist*, October, 1869. The article cited contains many notes upon botanical characters, &c., which are here necessarily omitted.

Salix (Willow). Several species not determined.
Populus angustifolia (Narrow-Leaf Poplar). Not east of base of Rocky Mountain, at Fort Benton and Fort Laramie.
Populus balsamifera (Balsam-Poplar). The prevailing species of "cottonwood" on Missouri River, above Fort Union and across Rocky Mountains; not uncommon to the west coast.
Populus tremuloides (Aspen). At intervals throughout the mountains, usually about gravelly ponds, but not common.
Pinus contorta (Twisted Pine). Most prevalent tree of higher Rocky Mountains, as far on the west slope as Deer Lodge Prairie. Beyond Bitter Root it again becomes abundant. Its growth seems more dependent on a certain degree of moisture rather than temperature.
Pinus rigida (Pitch-Pine). Common on east spurs of Rocky Mountains, in upper "Bad Lands" of the Missouri, from Milk to Judith River, and on Black Hills near Fort Laramie.
Pinus ponderosa (Yellow Pine). Prevailing species in most parts of Rocky Mountains traversed.
Pinus monticola (Western White Pine). Scattered trees on highest part of Rocky Mountains; from east base of Cœur d'Alêne Range to summit it is abundant, but disappears farther west.
Abies Menziesii (Black Spruce). Abundant on higher part of Cœur d'Alêne, as on the coast.
Abies grandis and *amabilis* (Oregon Yellow Fir). Perhaps the same species. From east slope Cœur d'Alêne Mountains westward.
Abies Douglasii (Red Fir). About same distribution as *Pinus ponderosa*.
Abies Williamsoni (Williamson's Spruce). Abundant *only* on summits of Cœur d'Alêne Mountains, where it grows 3 feet in diameter and 100 feet high.
Abies Mertensiana (Merton's Spruce). On slope of Cœur d'Alêne Mountains, but not on summit.
Larix occidentalis (Western Larch). Bitter Root Valley, and common to Fort Colville.
Thuja gigantea (Western Arbor Vitæ). Fully developed on western slope of Cœur d'Alêne Range; trees range from 6 to 8 feet in diameter, and very close together.
Juniperus Virginiana (Red Cedar). Large and abundant along the Upper Missouri, and more scattered across Rocky Mountains.
Taxus brevifolia (Oregon Yew). From eastern slope of Cœur d'Alêne Mountains westward to Lake Cœur d'Alêne.

In speaking of the supplies of timber for the mining interests of Montana, Mr. Raymond in his Report of 1870, p. 259, says:

Fortunately, Montana is much better timbered than the Territories farther south, although the forests are chiefly confined to the mountain ranges. Pine, fir, and spruce abound in the mountains and cañons, and small growths of balsams, alders, willows, and aspens are found in the valleys in the neighborhood of larger streams. In the immediate vicinage of active mining operations the supply is rapidly diminishing, and transportation from a greater distance is necessary; but the otherwise inexhaustible supply is more seriously threatened by the extensive forest fires. During the past dry summer (1869) these have been particularly disastrous, blackening an immense belt of country. The most charitable explanation of their origin ascribes them to carelessness or natural phenomena, as it is difficult to conceive the degree of wantonness and villainy necessary to undertake the intentional destruction of magnificent forests.

ARIZONA TERRITORY.

The mining enterprises of this territory have proved very destructive, and have exhausted the supplies of one place after another, until wood and timber are now procured only from considerable distances and at large and rapidly increasing cost. The difficulty and cost of procuring water by irrigation will probably prevent anything being done with success, excepting in the more favored localities, and as a general rule there can be no timber grown without this aid.

NEVADA.

An article on the resources of California, published in the summer of 1876, states that the mines on the Comstock Lode in Nevada use from 40,000,000 to 50,000,000 feet of timber per annum, involving the clear-

ing of about 3,500 acres of forest land yearly and a constantly increasing expense for logging, as the limit of supply was being rapidly approached. In addition to this demand for timber, the mines near Virginia City annually consume (according to the *Territorial Enterprise*) 40,000 cords of fire-wood, at an average price of $16 per cord. Lumber for mining purposes sold readily at Virginia City for $20 to $25 per thousand, embracing timber squaring 12 inches.

A correspondent in Elko County gives the following account of the forest resources of that portion of the State:

This region is in the great plateau between the Wahsatch and Sierra Nevada Mountains, and the locality reported from at the base of the Humboldt Range, latitude 41° 20′, longitude, 115° W.; elevation, 6,500 feet. This part of the State is about equally divided between mountain and valley. Rain-fall about 14 inches a year. The Humboldt Range rises 3,000 to 5,000 feet above the nearest arable lands, and its ravines and gorges are filled with groves of timber, the lower portion with quaking asp and balm of gilead, and the middle with groves of pine. The upper part of the mountain is covered with perpetual snow. The timber grows only in parts that are sheltered, the spaces between being covered with stunted quaking-asp and laurel, dwindling away and lost in utter barrenness toward the summit. The space between the laurel and the valley is covered with wild sage and wormwood, except the small groves of quaking asp that follow the mountain streams to the meadows, where they give way to the willow and osier that follow their course until it is dried up. On a lime-mountain, forty miles distant but in sight, there was a large grove of fir or spruce, covering, perhaps, ten square miles, but it has mostly disappeared. That mountain is 11,600 feet high; has a growth of mountain mahogany [*Cercocarpus*], giving it the appearance of a grove of gnarled apple-trees or burr-oak. Fifty miles south of here it is found all up the sides of the mountain, furnishing there the principal supply of fuel. The range east of the Humboldt Range is covered on its upper surface with pinon pine, and its lower part with juniper. The former supplies all the country hereabout, and the towns along the railroad, with fuel, and it is nearly all the timber in the eastern portion of Nevada. It is rapidly disappearing under the demands of the neighboring towns.

What our condition was for timber before this modern "upstart" Sierra Nevada raised his head between us and the clouds, is open to speculation. It is possible that under the *débris* in these valleys may be found beds of lignite or coal, that will supply the farmers and miners with fuel in the future. Well, we will trust it to the forestry commission and the subsidence of the Sierras.

There have been no experiments in forest-planting. Various seeds planted came to nothing. We have nothing for fencing, and fuel is getting scarce. We have no shade-trees around our dwellings. Nothing has resulted from government or State bounties for tree-planting. I have never noticed fungous parasites in the country. I have found galls upon the rose willow, sage, choke-cherry, and a wild unnamed shrub. We have a borer that destroys the pinon when kept in a dry place, and traces of insect-work are found under the bark of the quaking asp. An attempt to cultivate the large willow by covering cuttings with a plow, but it failed. The great need of this country is *some tree that will plant and tend itself*—something hardy—that will stand heavy winds and a cold as low as —10°. We have found nothing so far. As hardy a plant as the apple has failed under the shelter of a willow grove and a stone wall.—(*Mrs. E. R. Chase*, Wells, Elko County, Nevada.)

UTAH.

When the region now embraced within the Territory of Utah was first explored for settlement, about thirty years since, a large portion was an arid desert, and for the most part it was destitute of trees, excepting a scanty growth of cottonwood here and there along the streams, and a heavier growth of evergreens with few deciduous species in the cañons of the mountains.[1]

With scarcely an exception, it was necessary to provide irrigation before cultivation could be undertaken, and over extensive areas agricultural improvement can only be maintained through this means.

In 1867, 100,000 acres were irrigated, and $248,000 expended on canals and dams during the fiscal year ending October, 1867.

[1] The largest timber known to have been produced in the cañons of the Wahsatch Mountains hewed 70 feet long, and squared 8 inches at the smaller end. It grew in the Big Cottonwood Cañon.

According to statements made by A. M. Musser, before the Trans-Missouri Navigation Convention at Denver in October, 1873, there had been constructed in Utah, up to the year 1865, over 277 canals and ditches for irrigation having a total length of 1,043½ miles, and costing $1,766,939, or an average of $1,695 per mile. The estimated cost of works in progress was $877,730.

In 1872, returns from 25 main canals were received, showing the following results: Total length, 165 miles, varying from 1½ to 27 miles; width of bottom, 3 to 18 feet, average 6½ feet; depth, 4 inches to 3 feet, average 15½ inches; fall in a mile, 2½ inches to 75 feet, average 23⅞ feet; acres watered, 40,750, average to each canal, 1,638 acres.

He stated that when Salt Lake City was first founded, the water-capacity for irrigation did not exceed 800 or 900 acres; now between 4,000 and 5,000 acres are irrigated. The soil after becoming saturated and settled in the early years appeared to require less water, and it was found that after successive years of watering the upper or bench lands, the arable lands below needed no irrigation as the percolation from above was sufficient. As a general rule, the county courts regulate and control the waters in the main canals by the appointment of a head water-master, with subordinates.

The following statistics from the *Report of the Deseret Agricultural and Manufacturing Society* for 1875, contain the latest information that we have upon this subject in Utah:

Length of trunk irrigation canals (miles)	2,095½
Cost of the same	$1,918,174 84
Length of distributing canals (miles)	4,888½
Cost of the same	$503,320 00
Total cost of irrigation canals, including cost of repairs for 1875	$2,527,678 84
Annual cost of repairs	$106,184 00
Number of acres requiring no irrigation	77,525
Acres requiring from 1 to 2 hours of water per week	35,706
Acres requiring from 3 to 4 hours	87,774
Acres requiring from 4 to 10 hours	21,761
Acres reclaimed from salt and alkali lands	6,157
Acres reclaimed from swamp lands	3,490
Acres planted with nut trees	5½
Acres planted with shade trees	871

It is stated with much confidence that the necessity for artificial supply of water is every year becoming sensibly less, and that 77,525 acres are now reported as requiring no irrigation.[1] Popular belief is united in the opinion that the extremes of temperature are now less than formerly, the summer rains more frequent, and the climate more humid. They can now raise corn and other crops which could not formerly be done, on account of summer frosts, which do not occur now as in the early days of settlement.

With respect to the timber supplies of Salt Lake City, reliance was entirely had upon the cañons, and notably that of the Big Cottonwood, which opens into the valley from the east, about thirteen miles southeast of the city. It was first explored in 1853, and a road made under great difficulties, and, it is said, at a cost of $25,000. The most valuable timber which it supplies is the "red pine,"[2] "white pine,"[3] balsam fir, and

[1] In a visit to Salt Lake City in June, 1877, we were informed by President Brigham Young (since deceased), that during the present season, people in the valley were able for the first time to grow wheat without irrigation in places where it had formerly been quite impossible.

[2] Understood to be the *Pinus contorta*. Its wood has a reddish hue, and it is very strong and elastic. It is from this timber that the frame of the convex roof of the "Tabernacle" is constructed.

[3] *Abies Engelmanii* (?).

quaking asp. The latter is chiefly used for charcoal and fuel. The timber in this cañon, which is said to fairly represent that of the mountains of this region generally, occurs most towards the upper part, in coves and lateral valleys, and much more abundantly on the northern slopes.

From the deep snows that fall in these elevated regions, no lumbering can be done in winter; the streams although abundant in flow are of no use for transportation, and operations are now restricted to three or four months in the summer season. There are at present some seven or eight mills driven by water and one by steam in the Big Cottonwood Cañon. The machinery is of cheap and rude construction, with circular saws and overshot wheels. The production is from 2,000,000 to 3,000,000 feet a year. As the timber is cut off, the upper valleys are more exposed to sweeping winds, which carry the snows over the crests, where hanging masses form, until they fall, and, gaining force as they slide, sweep everything before them till they reach bottom of the valleys. Several acres of the asp and of small evergreens may be seen in several places that have been prostrated by these snow-slides, and their increasing frequency renders the reproduction of timber impossible. This is believed to fairly represent the timber of the cañons of this region generally. It is extremely difficult of access, quite limited in amount, and apparently without chances for renewal.[1]

The lumber markets of Salt Lake City and of Ogden are partly supplied with lumber brought from the Michigan and Wisconsin pineries, and from the lumber mills of the Coast Range and the Sierras, more particularly those of Truckee, near the eastern border of California. The redwood and the sugar pine of the Pacific Coast thus meet the white pine and the black walnut of the East in these middle markets of the continent. The fact that lumber is brought these distances by railroad, is a sufficient indication of its superiority in quality over the native woods of this region, or a sign of failure in their supply.

The mining operations of the Wahsatch and other ranges have created a new and extensive demand for timber and especially fuel.

The consumption of charcoal in the smelting-furnaces of the Territory is becoming every year a question of practical importance, and the difficulty of procuring it an increasing item of expense.

According to the statistics, published by the Deseret Agricultural and Manufacturing Society, for 1875, the amount of charcoal made in the Territory during the year was 8,674 tons, valued at $132,837.50. It is chiefly used in the silver smelting-furnaces of the valley, and the timber mostly used for this purpose is the quaking ash. This timber grows at the upper levels in the valleys, and well up to the timber-line.

The capacity of irrigated land for timber-growth is fully illustrated by the experiments already tried, and the latest returns show that about 880 acres have been planted in the Territory. This amount is altogether insignificant as compared with probable wants, and is not sufficient to

[1] Since the opening of numerous silver mines in the Great and Little cottonwood cañons, or rather on the dividing ridge that separates them, the timber has found a local demand which is hastening its destruction. In a recent visit to this country, an instance of reckless destruction came under notice, which cannot be regarded as unusual in the mining region of the West. The supply having failed in the Little Cottonwood, an adventurer had come over the snow-clad divide into the basin at the head waters of the Great Cottonwood, and cut down a million feet or more of valuable pine, as a speculation, but failing to realize from sales, it was left to rot on the ground. The rings of growth on one of the stumps thus cut, showed the age of the tree to have been over four hundred years, which may be regarded as about the usual period required for timber to grow to its greatest dimensions in these high altitudes.

account for the increasing volume of water in the Great Salt Lake in recent years.[1]

The trees first planted for shade and ornament in the streets of Salt Lake City were the native narrow-leaf cottonwood, which in late years have been attacked and to a large extent destroyed by a borer. A few of the broad-leaf species were planted, and these have suffered in like manner. In recent plantings, the cottonwoods have been altogether neglected, and many avenues of this tree are being replaced by other kinds, the black locust having preference, as regards number planted, although the honey-locust thrives extremely well, makes a finer-shaped tree, and produces a timber of better quality. The white and black mulberry, white and red elm, balm of gilead, ailanthus, and catalpa are found to thrive, and the box-elder grows with great luxuriance. The soft maples, and the sugar-maple grow but slowly, and for this reason are not regarded with favor. Most of the fruit-trees of the temperate zone are cultivated by aid of irrigation with great success.[2]

The reader is referred to an address by Prof. Paul Chadbourne (now president of William's College), before the Massachusetts Board of Agriculture (Report for 1871, p. 61), for many interesting details concerning irrigation, &c., in Utah.

Instances are mentioned of settlements being commenced in Southern Utah where the supply of water appeared scarcely sufficient for more than three or four families, but as the soil came to be cultivated the supply increased, so that now from fifty to a hundred families find support. These instances the leaders of the Mormon church claim of the fulfillment of prophecy, and an evidence of Divine favor. As *facts*, they can only be explained by attributing these changes to the conditions brought about by cultivation and planting. The amount of tree culture is not sufficient to account for any notable difference in climate, and the meteorological records of the Territory are too few and for too short a period to show any definite laws of climate. The average rain-fall at Camp Douglas, 3 miles east of Salt Lake City, from a series of records kept 10 years, is 18.87 inches. The months in the order of greatest rain-fall are: May, 3.02; December, 2.58; January and March, each 2.21; February, 1.38; April, 1.96; October, 1.22; November, 1.15; July, 0.85; September, 0.77; August, 1.70, and June, 0.62 inches.

The timber-line in the Uinta Mountains is 11,000 feet above tide; below this these mountains are covered with a dense forest very much interspersed with small openings of meadow.[3]

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[1] The facts relating to this increase, its causes, and the periods of its fluctuation, if such exist, belong to other departments of investigation. It is sufficient here to notice, that there can be no denial that the waters of the lake are now less salt than when settlement began, and some 12 feet deeper than in 1861.

[2] It is to be regretted that we have not sufficient instrumental records to show the foundation for the popular belief that the climate of Utah is now more moist and the temperature more uniform than it was thirty years ago. It is thought that showers are more frequent in summer than formerly, and corn is now raised in places where it was once liable to be killed by late spring frosts. The dews are now more abundant, and there is manifestly greater humidity in the climate than when this region was a desert.

The borders of the valley clearly mark the levels of the lake in ancient times as much above the present; and looking out, on a winter's morning, from the elevated site [of Camp Douglas], the valley is often seen filled with floating vapor to the highest level of the old lake-shore, and the valley with its thriving cities and settlements, and the bases of the surrounding mountains, are submerged, as it were, a thousand feet under water, forming a perfect image of the ancient scene.—(*Report on the Hygiene of the United States Army.* Circular No. 8, 1875, p. 338. Report of Surgeon E. P. Vollum.)

[3] Capt. W. A. Jones, United States engineer, in a *Report upon the Reconnaissance of Northwestern Wyoming*, p. 43.

CALIFORNIA.

This State, in common with the country further north, presents striking contrasts of abundance and destitution in regard to its timber supplies, suggesting active and efficient measures for conservation on the one hand, and patient and persevering efforts at restoration on the other. Nothing short of a discriminating and prudent policy on the part of the General and State Governments, in whatever comes within their province, and a thoughtful regard to future interests on the part of private owners of land, will save this region from the unpleasant consequences that would follow the entire exhaustion of the supplies of timber now available for commerce. In this question the consequences affect not only our own country, but also many others, who have been for years drawing upon these supplies as though they had no limit.

The worst feature of this question is, the thoughtless waste and total loss that has attended the management of these timbered lands, so far as owned by private persons, and the destruction that has happened in the want of management where the lands belonged to the Government. This waste by improvidence, plunder, and forest-fires, is more fully noticed elsewhere in this report.

Before noticing such details as we have been able to gather, we will present the observations of scientific observers as to the general character of the forests of this coast, and some official statements of the lumber production.

Dr. Asa Gray, in speaking of the contrast in vegetation between the Atlantic States and California, separated as they are by wide treeless plains and lofty mountains, says:[1]

> California has no Magnolia nor tulip-trees, nor star-anise tree; no so-called pawpaw (*Asimina*); no barberry of the common single-leaved sort; no Podophyllum or other of the peculiar associated genera; no Nelumbo nor white water-lily; no prickly ash nor sumach; no loblolly-bay nor stuartia; no basswood nor linden-trees; neither locust, honey-locust, coffee-trees (*Gymnocladus*), nor yellow-wood (*Cladrastris*); nothing answering to Hydrangea or witch-hazel, to gum-trees (*Nyssa* and *Liquidambar*), Viburnum or Diervilla; it has few asters and golden-rods; no Lobelias, huckleberries, and hardly any blueberries; no Epigæa, charm of our earliest spring, tempering an icy April wind with a delicious wild fragrance; no Kalmia, nor Clethra, nor holly, nor persimmon; no Catalpa-tree nor trumpet-creeper (*Tecoma*); nothing answering to Sassafras, nor to Benzoin tree, nor to hickory; neither mulberry nor elm; no beech, true chestnut, hornbeam, nor ironwood, nor a proper birch-tree; and the enumeration might be continued very much further by naming herbaceous plants and others familiar only to botanists.
>
> In their place California is filled with plants of other types—trees, shrubs, and herbs, of which I will only remark that they are, with one or two exceptions, as different from the plants of the eastern Asiatic region as they are from those of Atlantic North America. Their near relatives, when they have any in other lands[2] are mostly southward on the Mexican plateau, or many as far South as Chili.

Observations of Prof. J. S. Newberry upon the forests of California and Oregon.

Professor Newberry estimates the number of species of forest-trees growing north of San Francisco and south of the Columbia as not exceeding fifty, distributed among the following genera: *Pinus*, 8; *Abies*, 5; *Picea*, 3; *Sequoia*, 2; *Cupressus*, 2; *Thuja*, 1; *Libocedrus*, 1; *Larix*, 1; *Taxus*, 1; *Torreya*, 1; *Quercus*, 5; *Populus*, 3; *Salix*, 5; *Fraxinus*, 2; *Acer*, 2; *Alnus*, 1; *Cornus*, 1; *Platanus*, 1; *Castanea*, 1; *Æsculus*, 1; *Arbutus*, 1; *Oreodaphne*, 1. The conifers largely exceed the dicoty-

[1] Address before the *Am. Asso. for Advancement of Science*, Dubuque meeting, 1872. p. 9.
[2] *Pacific Railroad Survey*, vol. vi, Botany, p. 11.

ledonous trees, both in size and numbers, and the heavy forests are mostly limited to the sea-coasts and mountain-sides, and he observes that different mountain-ranges are covered with vegetation that exhibits marked differences when compared one with another.

The areas between and eastward of the coast-ranges and Sierra Nevada have each a flora somewhat peculiar to themselves.

Coast Mountains, between San Francisco and the mouth of the Columbia.—These were covered, when observed by him in 1854–'55, with a continuous forest, denser toward the north. Immediately north of San Francisco they were almost exclusively of redwood (*Sequoia sempervirens*), which was limited to the valleys, especially such as opened toward the coast. Farther north the trees became more numerous, and the sugar and yellow pines (*P. Lambertiana* and *P. ponderosa*) were found. Near Crescent City these trees together formed a magnificent forest, the redwoods and sugar-pines growing to about equal dimensions, being not uncommonly 12 to 15 feet in diameter and 300 feet high.

Near the line of 42° a change was observed, growing if anything more dense, and the redwood disappearing and being succeeded by the Western white cedar (*Thuja gigantea*), Douglas and Menzies's spruces, which formed dense and almost impenetrable forests from Port Orford to the Columbia. The Douglas spruce here reached its greatest size, fully equaling the redwood and sugar-pine. In the valleys of the Umpqua and other rivers flowing into the ocean the *Quercus Garreyana* grows alone or in groups, sometimes 2 to 3 feet in diameter, with a low, spreading top. In the transverse chains running back from the coast to Mount Pitt and Mount Shasta, the *Pinus Lambertiana*, *P. ponderosa*, *P. contorta*, *Picea grandis*, and perhaps *P. amabilis*, reached down nearly to the shore.

Sacramento Valley.—Excessive moisture in winter and spring, and summer droughts, characterize this region. The prevailing surface is prairie, with timber in narrow belts along the streams, varying in width and density according to the size of the streams and the extent of their influence upon the soil or air. Of trees growing in this region he mentioned the *Quercus agrifolia* and California white oak (*Q. Hindsii*), the nut-pine (*P. Sabiniana*), a tree highly characteristic of the flora of the interior, and generally distributed in the Coast Mountains back from the ocean. The manzanita (*Arctostaphylos glauca*), *Platanus racemosa*, *Fraxinus Oregona*, *Populus monilifera*, and a few willows, alders, and vines make up the rest.

Sierra Nevada.—These mountains, with their continuation—the Cascade Range of Oregon—rising at many points high above the line of perpetual snows, give an alpine character to some of the vegetation, and, with the progressive changes downward, quite a variety of species. The Douglas spruce, the western balsam-fir, and some other trees which form a large part of the forests on the Columbia, extend at a higher elevation down to Mexico. The western slope, receiving rains from the Pacific, was clothed with a dense forest of conifers, including, with the exception of redwood, all those gigantic species that characterize the botany of western North America. On the west slope of the Sierra Nevada also occurs the *Sequoia gigantea*, or "mammoth tree." The greater part of the forests were made up of the yellow pine (*P. ponderosa*), sugar-pine (*P. Lambertiana*), western balsam-fir (*Picea grandis*), and incense-cedar (*Libocedrus decurrens*), which formed the greater part of this slope as far south as the latitude of San Francisco. The yew (*Taxus brevifolia*), and two species of cypress (*C. Nutkatensis* and *C. Lawsoniana*) were occasionally met with. Among the foot-hills, at a lower level, the nut-pine mingled with the oaks, reaching up to the pine forests above, but scarcely forming a part of them. The *Quercus fulvescens*, *Q. densiflora*, and *Q. Kelloggi* also occurred in the same zone, but not in considerable numbers.

Region east of the Sierra Nevada and Cascade Mountains.—There is here great uniformity in geological formation as well as in vegetable growth; the yellow pine (*P. ponderosa*) forming a continuous forest, a day's ride scarcely showing a dozen species of plants.

The Klamath Lakes, and along the Klamath River, in Oregon, where more rain falls, we have thickets of small trees, but the amount of timber is not large. The cottonwood and willows were found along water-courses, and yellow pine and western cedar on the hills. On the banks of the Klamath dense forests of the *Pinus contorta*, of small trees, were noticed.

Cascade Mountains.—These bear, besides the greater part of the species found on the Sierra Nevadas, some that do not extend into California. The western larch (*Larix occidentalis*) and the *Abies Williamsonii* are of this class.

Among the species mentioned in the local botany of this region, were the larch and several of the poplars (*Populus tremuloides*, *P. monilifera*, and *P. angustifolia*). A few hundred feet up the mountain-side the yellow pine, joined by the sugar-pine (*Pinus contorta*), western balsam-fir and Douglas spruce, together formed a thick forest. There were also seen some few trees of the *Thuja occidentalis* and large-leaf maple (*Acer macrophyllum*). A little higher was the *Pinus monticola* of Douglas, and

the silver fir (*Picea amabilis*). At 6,000 feet these gave place to the *Abies Williamsonii* and *Pinus cembroides*, which rise to perpetual snow. These species are observed on the Eastern slope. On the Western slope they appear mingled with others, the great mass of the forest being made up of the Douglas spruce, the balsam-fir, and western arbor vitæ. The Nootka cypress is confined to the western slope. These mountains, near the Columbia, are chiefly timbered with Douglas spruce and Western balsam-fir. The banks of the river are lined with cottonwoods, and in some places with Garrey's oak.

The lowest part of the Willamette Valley was occupied by the densest forest seen, composed chiefly of the Douglas spruce (here known as red fir), the western balsam-fir (here called white fir), hemlock, spruce, and arbor vitæ. Of dicecious trees, the large-leaf and vine maples (*A. macrophylum* and *A. circinata*) and the *Cornus Nuttallii* were the principal species.

Prof. J. D. Whitney, in connection with the geological survey of California, has given a general view of the distribution and character of the forest vegetation of the Sierra Nevada region.

In so elevated a range as the Sierra Nevada we should expect to find a number of belts of forest vegetation corresponding to the different zones of altitude above the sea-level. As in the Coast Ranges, the general character is given to the landscape by coniferous trees and oaks, all other families being usually quite subordinate in importance, and the number of the conifers as compared with that of the oaks increasing rapidly as we ascend.

There are four pretty well marked belts of forest vegetation on the west slope of the Sierra, and that of the eastern slope would make a fifth for the whole range. These belts, however, pass gradually into each other, and are not so defined that lines can be drawn separating or distinctly limiting them, and the division into groups or belts here proposed will only hold good in the central portion of the State. As we go north all the groups of species gradually descend in elevation, especially in approaching the coast.

Of the four belts on the western slope of the Sierra the lowest is that of the foothills, extending up to about 3,000 feet in elevation. Its most characteristic species are the digger-pine (*P. Sabiniana*) and the black oak (*Q. Sonomensis*). These stand sparsely scattered over the hill-sides or in graceful groups, nowhere forming what can be called a forest. The pale bluish tint of the pine leaves contrasts finely with the dark green of the oak foliage, and both pines and oaks are strongly relieved in summer against the amber and straw-colored ground. The small side valleys, gulches, or cañons, as they are called in California, according to their dimensions, are lined with flowering shrubs, of which the California "Buckeye" (*Æsculus Californica*) is, at this altitude, by far the most conspicuous, gradually giving place, as we ascend, to the various species of the delightfully fragrant *Ceanothus* or California lilac. Manzanita and chamiso are of course abundant everywhere, and especially on the dryest hill-sides and summits.

The next belt is that of the pitch-pine, or *Pinus ponderosa*, the sugar-pine (*P. Lambertiana*), the white or bastard cedar (*Libocedrus decurrens*), and the Douglas spruce (*Abies Douglasii*). This is peculiarly the forest-belt of the Sierra Nevada, or that in which the trees have their finest development. The pitch-pine replaces the digger-pine first, and more and more of the sugar-pine is seen from about the altitude at which the last-named noble and peculiarly Californian tree is most abundant. The sugar-pine is remarkable for the size of its cones, which hang in bunches of two or more from the ends of the large branches, like ornamental tassels. The timber of this tree is the best that California furnishes, and its size gigantic, being not unfrequently 300 feet in height, and from 7 to 10 feet in diameter. It is also in this belt that the "big trees" belong.

The third zone of forest vegetation is that of the firs (*Picea grandis* and *amabilis*) with the tamarack pine (*P. contorta*), taking to a considerable extent the place of the pitch and sugar pines. This belt extends from 7,000 to 9,000 feet above the sea in the central part of the State. The traveler to the Yosemite will see it well developed about Westfall's Meadows, and from thence to the edge of the valley. These firs, especially the *amabilis*, which is distinguished by the geometrical regularity with which its branches are divided, are most superb trees. They attain a large size, are very symmetrical in their growth, and have a dark green brilliant foliage, which is very fragrant. A pine called *Pinus Jeffreyi*, by some considered a variety of the *ponderosa*, is also a characteristic tree of the upper part of this belt, and above this sets in the *Pinus monticola*, which takes the place of the *Piceas* at a high elevation.

The highest belt of all is that of the *Pinus albicaulis*, or *flexilis* of some botanists, which marks the limit of vegetation in the Middle and Northern Sierra, *Pinus aristata* taking its place in the more southern region, about the head of King's and Kern Rivers. The *P. albicaulis* generally shows itself at the line just where vegetation is going to give out altogether, as around the base of Mount Clark, Mount Dana, and Mount Shasta.

On the last-named mountain it was seen growing as a shrub, in favorable places, up to 9,000 feet, and small trees were so compacted by the pressure of the snow on them in winter that a man could easily walk over the flat surface formed by their foliage. A little clump of this species just at the edge of the snow, on Lassen's Peak, shows the aspiring character of this tree, which is one widely distributed over the high mountain tops of the Cordilleras. The *P. aristata* is also found in the Rocky Mountains, as well as along a limited part of the highest region of the Sierra Nevada.[1]

Mr. C. H. Reed, president of the State Board of Agriculture, in 1868, estimated that a twentieth part of California was covered with heavy timber, and about an eighth, more or less, with trees of some kind. Within twenty years, at least a third of the whole native supply of accessible timber had been cut off or destroyed, and that, judging the future by the past, it would require about forty years to exhaust the entire present supply. This did not include estimates of the demands that might arise from increased population, or the extension of new industries, which might reduce the term to twenty years. One of the worst features in respect to this subject was the useless and criminal destruction of timber, which had been indulged in to an unprecedented extent. He says:

Thousands upon thousands of the noblest and most valuable of our forest-trees in the Sierra Nevada districts have been destroyed without scarcely an object or a purpose—certainly with no adequate benefit to the destroyer, or to any one else. This practice cannot be condemned in too severe terms; it cannot be punished with too severe penalties.

The hard-woods of California afford some noble specimens of ornamental woods; but for the strong and elastic kinds, used by carriage-makers, and for agricultural implements and the wood-work of machines where great toughness is required, the supplies come wholly from the Atlantic States. Mr. Reed, in 1868, says:

Even now the cost and scarcity of these articles are having an oppressive effect upon every industry in the State. The expense of agricultural implements and tools here over their cost in the Eastern States is already operating as a serious drawback upon the thrift and profit of our farmers, brought in close competition, as they now are, with our neighbors of the Western Atlantic States. The cost of lumber for building and fencing, in most of our agricultural districts, obtained, as it is, at a distance of hundreds of miles away, is even now so great that our farmers are among the poorest housed people of any agricultural community in the Union, where the country has been settled an equal length of time. Their crops and stock are but poorly sheltered, if at all, and their farms are worse than poorly fenced. To the expense of lumber, more than any other cause, must be attributed the general dilapidated appearance of our agricultural districts.

This scarcity had led to forced systems of farming—too frequent cropping, too little nursing, and consequently too rapid exhaustion. Building improvements were checked, and the enhanced cost of lumber had raised the prices of rent. He concludes this statement with the question, which the future must answer: "If this be the case now, when we are so young, and our population so thin, when the demand for these articles is increased twenty-fold, and the supply decreased in the same ratio, who can depict the condition of our State?"

REDWOOD OF CALIFORNIA (*Sequoia sempervirens*).—This belongs to the same genus as the giant trees of Calaveras, Mariposa, and other points; is first in importance among the timber-trees of California. It sometimes occurs fifteen feet in diameter and three hundred feet high; and instances are mentioned of specimens twenty feet in diameter. It grows only on underlying metamorphic sandstone, and does not thrive in other formations. The redwood belt extends from Humboldt County, near the northern border, and reaches down the coast for a hundred

[1] *Yosemite Book.*

and fifty miles, terminating in Sonoma County. From Valhalla, the north boundary-line of Sonoma, to Russian River the country along the coast is timbered, and this timber extends inland about eight miles. The timber in the Russian River bottom is not surpassed on the coast. Fed by the rich alluvial soil and watered by annual overflows, the trees grow to an enormous size, some being 150 feet without a limb, and cases have occurred in which a single tree has been worked up into 65,000 feet of lumber, worth at least $1,000.[1]

The redwoods are not continuous, several interruptions occurring from change of geological formation from sandstone to lime-rock, or from the lowering of level. An instance of the former is seen at Tomales Bay; and of the latter from the lower foot-hills of Tamalpais down to Belmont. A connecting link is found, however, on the Oakland hills, and that grove of redwood, now almost destroyed, affords the strongest evidences of the dependency of this species on the prevalence of heavy mists. A few individual trees occur across the Oregon line, but none of commercial importance. A few small patches occur in Marion County, but these are fast passing away. It also occurs in Klamath and Del Norte Counties, in more or less disconnected patches. The redwood belt, at its best, is almost fifteen miles wide, but the average width is much less.

This is one of the very few of the conifers that sprouts from the stump when cut down. Fire is destructive to the young trees only, and after gaining a thickness of two or three feet, they are not liable to injury from this cause. The roots seem imperishable, and as soon as the tree is cut, they sprout and cover the soil rapidly, to the exclusion of every other species, none being of so rapid growth. The indestructibility of the roots prevents the clearing of such land, and even large trunks cut down, cover themselves, within two or three years, with sprouts so completely that they can scarcely be seen. The entire aftergrowth on the Oakland hills is owing solely to this growth from the roots and stumps. This tenacity of life shows itself also in the resistance it offers to fire. Trees that have been bereft completely of their branches by fire, will

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[1] The wood in the tree standing is valued at the present time at $2 per M feet, a yield of 150,000 to the acre, or 6,000,000 on a forty-acre lot is an average on good lands. The very finest timber on the margin of the streams would produce at least 800,000 feet to the acre, and this yield runs down to 25,000 feet. As the redwood belongs to the foggy coast region, and as the supply south of San Francisco has been cut off, Sonoma, Humboldt, and Mendocino Counties may be said to have the monopoly of this timber while it lasts.

The yield of redwood lumber in 1876 was estimated at about 216,000,000 of feet.

The redwood is a close-grained timber, splits true, is very light in color, like the red cedar of the Eastern States. It works smoothly under the plane, and is not liable to warp or shrink. Its durability cannot be questioned, as hundreds of miles of fences twenty years old and still sound bear evidence. Hence it has been used largely for fence-posts and railroad-ties. Sonoma and Mendocino Counties furnish large quantities of ties to the Central Pacific Railroad. It is also used on the Southern Pacific, and is largely laid on the desert of the Colorado and in Peru. The late Henry Meigs, the projector of extensive railroad enterprises in South America, once owned a mill in Sonoma County, and appreciated the durable qualities of this timber.

The redwood varies in density, the heaviest being of a dark red color, and the lighter in weight being lightest in tint. Its average weight is 4½ pounds to the square foot. One instance was observed in which the timber sawed from a gulch weighed but 2½ pounds to the foot, while that from another, but a quarter of a mile off, parallel and leading into the same main cañon, was 6 pounds to the foot.

The trees growing on a gravelly soil are generally unsound on the top and in the heart, rotting from the top downward. When the tree stands on ground where the underlying rock is of a shelly or broken nature the timber is apt to be unsound. Upon precisely the same kind of soil, when the underlying strata are solid, the wood will be solid. The best timber is, of course, along alluvial river-bottoms, which rest upon a solid sandstone formation, though a good deal of hill-side timber when the rock is solid will make the best of lumber.—*Sonoma Democrat.*

cover themselves with young sprouts, like a dead trunk overgrown with ivy.[1]

A redwood forest is described as grand beyond power of appreciation to one who has not witnessed the dense masses of fog come rolling in from the Pacific, creeping through the foliage, covering the hill-tops, flowing down the opposite slopes, and filling the cañons until hill and valley are wrapped in dripping mist, or, as the process is reversed in early light of morning, as these fogs melt away and reveal the forests, in all their grandeur of dimensions and distance, stretching away until lost to view on the far-off horizon.

We may judge something of the requirements of the redwoods in any attempt at their naturalization elsewhere by noticing the climate in which they thrive. The seasons are alternately wet and dry. Rains begin in October and continue to occur till May, or rarely in June. It seldom rains more than three or four days at a time, and as soon as the rain-fall begins the herbage starts, so that by the middle of November the hills and pastures are green. December is a stormy month, with some snow and ice. January is a month of flowers and the seed-time of grains. Planting is done either in the fall or in January and February, or the first days of March. February is the growing month, like June in the Northern Atlantic States. March is a rude month, with southeast storms or dry north winds. April is a month of fluctuating weather, of rapid growth, and the rains being well nigh over, the moisture depends in part upon sea-fogs. Grain ripens in June, and is harvested in July. Fogs prevail from May to August, brought in the form of damp air by the trade-winds from the sea, and condensed by cooling on the mountains. When the trade-winds set in a fog-bank forms every day off the land, and in the afternoon it comes inland, spreading over the country through the rest of the day, and nearly through the night, thus repeating itself nearly every day through their season. The farmers estimate these heavy fogs as about equal to a light rain.[2]

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[1] *Proceedings of California Academy of Natural Sciences*, iii, 232.

Dr. Gray, in an address before the American Association for the Advancement of Science, at Dubuque, in 1872, remarks as follows, concerning this timber:

"The forests of California, proud as the State may be of them, are already too scanty and insufficient for her uses. Two lines, such as may be drawn with one sweep of a brush over the map, would cover them all. The coast redwood, the most important tree in California, although a million times more numerous than its relative of the Sierra, is too good to live long. Such is the value for lumber, and its accessibility, that, judging the future by the past, it is not likely, in its primitive growth, to outlast its rarer fellow-species."

[2] R. A. Thompson's *History of Sonoma County, California* (1877), p. 20.

Dr. Henry N. Bolander, in a paper presented to the California Academy of Sciences, October 16, 1865 (*Proceedings* iii, 232), ascribes great importance to these fogs. In this article he says:

"Another great beneficial feature in this species (*Sequoia sempervirens*) is the great power it possesses in condensing fogs and mists. A heavy fog is always turned into rain, wetting the soil and supplying springs with water during the dry season. Springs in and near the redwoods are never in want of a good supply of water, and crops on the Coast Ranges are not liable to fail. The year of 1874 has proved my assertion beyond a doubt. This fact is generally known; a great deal of land has been taken up since. It is my firm conviction that if the redwoods are destroyed—and they necessarily will be if not protected by a wise action of our government—California will become a desert in the true sense of the word. In their safety depends the future welfare of the State. They are our safeguard. It remains to be seen whether we shall be benefited or not by the horrible experience such countries as Asia Minor, Greece, Spain, and France have made by having barbarously destroyed their woods and forests. But with us here it is even of a more serious nature. Wise governments would be able to replace them in those countries, but no power on earth can restore the woods of California when completely destroyed."

In the recently published history of Sonoma County the names of 14 establishments are given, of which 1 has a daily capacity of 35,000 feet of lumber; 9 of 30,000; 1 of 15,000; 2 of 12,000; and 1 of 10,000. Total, 354,000 feet a day, or 57,000,000 a season. Others are mentioned as preparing to operate, and extensions of narrow-gauge railroads were contemplated, which would largely increase the production. It also gives the following

Tabulated Statement of Timber Resources by Sections.

	Feet.
Between Valhalla and Russian River	437,000,000
Duncan's Mill Land and Lumber Company	216,000,000
Russian River Land and Lumber Company	450,000,000
Bodega country and north of Howard's Cañon	345,000,000
Opposite Guerneville	35,000,000
Hurlbut's Cañon, Big Bottom, Elliott's Cañon	350,000,000
Marshall timber on Mill Creek	15,000,000
	1,848,000,000

We have no means of verifying this estimate; but allowing a broad margin for error on the most favorable side, the period of exhaustion is not many years distant at best, and the subject should arrest the attention of capitalists in view of the large gain that may be realized in the future, by arresting thoughtless waste, introducing economical methods, and especially by carefully protecting the woodlands when once cut over, and allowing them the best possible conditions for reproduction.

THE "BIG TREES" OF CALIFORNIA (*Sequoia gigantea*).—These have attracted widely the public interest, rather on account of their enormous dimensions than their commercial importance. In fact, their very rarity led the General Government, a few years since, upon the memorial of a number of influential citizens of California and other sections of the country, to except the more important groves then known and the Yosemite Valley from sale, and to reserve them, under the care of the State of California, as places of public interest.[1]

[1] The "Cleft" or "Gorge," in the granite peak of the Sierra Nevada Mountains, at the headwaters of the Merced River, and known as the Yosemite Valley, estimated at fifteen miles in length, with an average width of one mile back from the main edge of the precipice on each side, was, by an act of Congress approved June 30, 1864, given to the State of California, upon condition of its being held for public use, resort, and recreation, and inalienable for all time. All incomes from leases or privileges were to be applied to preservation and improvement.

By the same act, the tracts embracing what is known as the "Mariposa Big-Tree Grove," not exceeding the area of four sections, and to be taken in legal subdivisions of one quarter section each, were also given to the State, with like conditions as to acceptance, inalienability, lease of privileges, and protection. Both these cessions were to be managed by commissioners, consisting of the governor and eight others, to be appointed by him, and to serve without pay.

This act was accepted by the State, in an act passed April 2, 1866, and commissioners confirmed. They might appoint a guardian with a salary of not over $500, and the State geologist was authorized to make a full survey and a statistical report. Penalties were imposed for injuries to timber, careless fires, &c., and a small appropriation was granted for expenses. The State has of late years allowed this trust to fall in arrears in its financial matters, by omitting to appropriate the means for paying the salary of its superintendent. It cannot, however, be supposed that it will permanently allow these irregularities to continue. The title of the Yosemite property has been a subject of litigation, and after a decision in the State courts in favor of the claimant, the title has been affirmed to the government by the Federal courts. The generic name of the "big trees," and of the redwood is derived from that of a Cherokee chief, whose English name was George Guess. He was the inventor of a system of syllabic writing which possessed such advantages and was learned with such facilities, that it speedily became a means of written communication among his people, and is still used by them.

The "big trees" have in recent years been found in large quantities, and both large and small in size in the Sierras at from 4,500 to 8,000 feet above sea level.

The best-known groves of the *Sequoia gigantea* are those of Calaveras, Tuolumne, Merced, and Mariposa. In Fresno County there have been found in recent years others, large and small, and the species is preserved to science in an abundance of young trees raised from seed in various parts of the world.[1]

The genial influence of snow in favoring tree growth is finely illustrated in the case of the "big trees" of California. The climate in summer is warm and dry, and it seldom rains, but the snows fall six feet or more in winter and lie on till May. From the absence of rains the soil is deep and the rocks are hidden by it. At the Calaveras Grove the ground appears to be much lower and more wet in summer than at Mariposa, and at the latter the trees are more widely spread on the slopes and high knobs of ground where the drainage is good.[2]

Height.	Circumference.	Height.	Circumference.	Height.	Circumference.
258	31	305	63	269	64
260	50	270	49	366	50
273	32	320	42	308	48
280	48	327	45	310	—
265	46	284	52	241	44
291	45	258	—	275	50
305	49	315	—	259	44
281	44	277	45	286	50

The circumference was measured above the swell of the roots, at about six feet from the ground. The diameter of the stump of the "original big tree" was 23 feet 1½ inches inside of the bark, which was two feet thick.—(*Proceedings of the California Academy of Natural Sciences*, iii, 204.)

A particular account of these trees will be found in the "*Yosemite Book*," published in connection with the Geological Survey of California, under the direction of Prof. J. D. Whitney, State geologist, and by authority of a State law.

EUCALYPTUS GLOBULUS.—*The Blue Gum of Australia.*—As much has been written concerning this species, and as efforts have been made with much success to introduce its cultivation in California, it may be proper to present some of the principal facts concerning it:

Our knowledge of this tree dates from 1792, when Labillardière, who was sent with the expedition in search of the unfortunate La Perouse, found it in Tasmania, and brought it to Europe.[3] But public attention was not called to it until its rediscovery,

[1] The giant sequoia was introduced into England in 1853, and it has been tried in that country and Scotland in a great variety of situations, to ascertain its preferences. It is found to do much the best in heavy clay land. It suffers from the easterly spring winds, but after a time recovers. It must have a damp climate, moist subsoil, prefers high grounds to low, and is sometimes injured by severe frosts. It is hardy at 800 feet above tide, where the Douglas spruce did not do as well. Taking into consideration its hardiness, rapid growth, large dimensions, and durability, it is thought to present qualities that render it proper for forest planting for future timber; but it must not have exposure to the east winds. The value of its wood has not yet been tested. An interruption of growth in midsummer, followed by a vigorous growth in the fall, has been noticed, probably causing confusion in the rings of wood, or perhaps a double ring in a year. It was introduced into France in 1854, and grows alike on plains, in valleys, and on hills, best on a northern or southern slope. It must have a sufficient depth of soil, and proves very difficult to transplant.—(*Les Conifères*, C. De Kirwan, ii, 66.)

This tendency to start again in autumn, due to the wet and dry seasons of its native locality, has very frequently proved fatal in the Atlantic States.

[2] The following are measurements of height and circumference of 25 trees in the Calaveras Grove, made by Dr. Charles T. Jackson and Joseph B. Meader, in 1865. The quantities are in feet:

[3] This naturalist, with rare sagacity, foresaw that this tree would become an important source of timber for ship-building. His journal, under date of May 12, 1792 (the expedition being then at the Bay of Tempests, Van Diemen's Land), says: "I have not yet been able to procure the flowers of a new species of Eucalyptus, remarkable for its fruit, which resembles a coat-button. This tree, which is one of the tallest in nature, since it measures upward of 160 feet, only blooms toward its upper extremity. The wood is suited to naval construction, and is durable, but neither so light nor so elastic as pine. Perhaps it would be advantageous, in making masts of it, to make them of many pieces, and to hollow the great trunks throughout their lengths, in order

so to speak, by M. Ramel, in 1854. Being then at Melbourne, Australia, his attention was attracted by the extraordinary vigor of growth of a young plant in the botanical garden of that city, and its graceful form and beautiful foliage. He brought its seed to Paris, and had no difficulty in making them grow vigorously in summer, but they were killed down by frost in winter. Although under glass they grew with the same vigor, and soon reached the utmost limit of their space, so as to bend over under the roof. Some plants, sown in 1861, when placed in the open air, in 1872, grew so rapidly that the idea was suggested of trying them in Algeria and the south of France. It was introduced in Corsica, in 1865, and a report made in March, 1870, states as the result of observation that they would prosper around the borders of the island, and to an elevation of about 400 feet above sea-level. Its power of absorption of moisture and its emanations tending to purify the atmosphere were commended, and its growth was rapid; trees but six years old measuring 50 inches at 20 inches above the earth.[1]

In the winter of 1870–71, a large number of these trees, which had flourished ten years, were killed down by frost in the basin of the Rhone. Near Cannes a few resisted the cold. At Madrid, wood of three or four years' growth withstood the frost, and put forth shoots vigorously.[2]

A report from Nice, July, 1871, was not favorable. The tree was found to require a deep, fertile, and well-irrigated soil, without which it would perish in seasons of drought. A temperature of 40° to 43° Fahrenheit would seriously affect it, and it could not withstand the violent winds which blow in the winter months along the northern shore of the Mediterranean. The writer of this account expresses the opinion that it could not be raised in France to advantage, or at least not in thickets, with the design of extracting its essential oils.[3]

It was first introduced into Algeria in 1854, in the garden of Hamma, near Algiers, under the direction M. Hardy, and a writer in 1867 estimates that a hundred thousand plants had been distributed in different provinces, and its success equalled the highest expectations that had been formed concerning it.[4] M. Planchon, in speaking of its cultivation in that country (1874), says: "In Algeria it is most favorably naturalized. It triumphantly borders the railways, of which it has seen the birth and marked the date. The garden inclosure can no longer retain it. It is planted by hundreds of thousands, in groves, in avenues, in groups, in isolated places, in every section of the three provinces, and the foreigner who does not know the exotic origin of the Eucalyptus, would suppose it to be an indigenous tree."

This tree has been introduced in India, the Cape of Good Hope, Argentine Republic, Chili, Central America, California, and various West India Islands. The genus *Eucalyptus* embraces an immense number of species, about 140 being described by Bentham and Von Müller in their *Flora Australiensis*. They differ greatly in size, habit of growth, and qualities, and several of them possess valuable medicinal properties. The *E. globulus* grows in its native country to an immense size, rivaling the giant *Sequoias* of California.[5] The *E. amygdalina* has been seen 480 feet high.[6]

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to give them more lightness, strengthening them by iron bands." The specific name was suggested by the fruit, which resembles an urn rather than a button. The form is that of a reversed cone, raising four prominent sides, slightly widened at the edge and hollowed in the center by four cells, which open by large radiating aboulders, separated by as many triangular tongues. Before flowering, this inferior part of the calyx, which becomes the fruit, bears a thick, wrinkled, conoidic cap, which some botanists believe to be the superior part of the calyx; others a corolla with consolidated stamens. It is from this covering that the plant receives the name of *Eucalyptus*, from two Greek words signifying "I conceal well," the cap for a long time concealing the stamens.—*Planchon's Eucalyptus globulus*, p. 9. Translated and published by the Department of Agriculture (1875).

[1] *Bulletin de la Soc. d'Acclimatation* [2], ix, 445.

[2] *Ib.* [2], viii, 148, 384.

[3] *Ib.* [2], viii, 387; see also *ib.* [2], ii, 672.

[4] *Revue des Eaux et Forêts*, vi, 16.

[5] In an expedition into the interior of the Australian continent by Walter Hill, a government botanist, the Eucalyptus was found at an elevation of 4,000 feet above sea-level, 159 feet in circumference at 3 feet from the ground, and 80 feet in girth at 56 feet. Shipbuilders procure timber in single pieces for keels 120 feet long, and for planking of vessels it is considered superior to American rock elm.

A bibliography of pamphlets and articles upon the *Eucalyptus* is given in the *Bulletin Mensuel de la Soc. d'Acclimatation* for January, 1877 (3d ser., iv, p. 59–63), and a list of species in the same journal for April, 1876. A large number of American publications upon this subject are omitted in the list cited.

[6] *Transactions and Proceedings of the Royal Soc. of Victoria*, Part I, vol. viii, p. 9.

It is particularly successful in the French colony of Reünion, where M. de Châteauvieux is occupied in the cultivation with marked success.

The superintendent of the botanical garden, Jamaica, reports (in 1877) that the blue gum, planted six years ago in the Cinchona plantations, were 60 feet high, with trunks a foot in diameter near the ground, and 6 inches at 20 feet. During the past year 3,000 plants were distributed, in addition to 2,000 the year before. Most of these were sent to the lowlands, where they do not succeed as well as those planted on the hills. He says:

The value of this plant on the hills consists in its importance as a timber tree, as it is not only one of the most durable and useful woods, but it grows with greater rapidity and to a larger size than any other known timber tree. Judging from the rate of growth attained by plants introduced six years ago, trees two feet in diameter are certainly producable in ten years from seed. It possesses another advantage, namely, the branches are not wide-spreading, like most other trees; hence, in forming a plantation, the plants may be set unusually thick.

The lowest altitude at which this tree should be planted within the tropics is probably 2,000 feet. The imports of timber in Jamaica amount to about 8,000,000 feet of timber and 5,000,000 of shingles.

The *Eucalyptus globulus*, and several other species of this genus, have been introduced into California with much success, and Prof. Robert E. C. Stearns, in a paper published in the proceedings of the California Academy of Sciences, July 1, 1872,[1] says:

An instance of rapid growth under my immediate observation is that of a specimen purchased by me of a nurseryman, which, at the time of planting (January 5, 1871), measured from the ground level to the extreme tip 6½ feet, and in about eleven months (December 8, 1871) had reached a height of a trifle over 15 feet. The diameter of the stalk when set out was half an inch, and at the final measurement 1¾ inches. I am prepared to hear of instances far exceeding my figures, but it should be borne in mind that we had very little rain after this tree was planted, and furthermore, that the locality was upon nearly the highest ground in Petaluma. This tree was occasionally, but only moderately, watered during part of the time. Other trees of this species planted at the same time also made a remarkable growth. Specimens raised by me from the seed, whose growth I have noted, show a gain of 10½ inches in 21 days, or half an inch per diem. The development of lateral branches is as suprising as its perpendicular growth. George C. Potter, esq., of Oakland, informs me that specimens upon his grounds nine years old, show a diameter of 12 inches.

The late Col. Ezekiel Jewett, in writing from Santa Baraba, Cal., September 13, 1876, says:

There are some thirty species of the Eucalyptus here, and their growth is marvelous. The blue gum seems to be the favorite, and there is one before me, three years and one month old, that is 20 inches in circumference 6 feet from the roots, and 32 feet high.

Professor Brewer cites from a local authority that a tree cut in 1874, in Sonoma, Cal., of 9 years' growth, which had attained the height of 96 feet, and a diameter of 18 inches at 4 feet from the ground.

Mr. Ellwood Cooper, of Santa Barbara, who has done much toward making known the value of this timber for cultivation,[2] in writing, November 28, 1876, says:

The only parts of California that have commenced the planting of Eucalyptus forests, so far as my knowledge extends, are Alameda County, Gen. J. T. Stratton, the principal, some 60 acres; in San Rafael there are probably 50 acres; in Los Angeles County, 100 acres; Santa Barbara County, 100 acres. In other parts of Alameda

[1] *On the Economic Value of certain Australian Forest Trees, and their Cultivation in California.*

[2] *Forest Culture and Eucalyptus Trees.* San Francisco, 1876. 12mo., pp. 204; and an other volume of the same title, pp. 621. The first of these contains a lecture by him, and two lectures and an article by Baron Ferdinand Von Müller, of Melbourne, Victoria. The larger volume embraces several lectures and articles by Baron Von Müller having an interesting application to the subject of Australian vegetation and its introduction into California.

County there are doubtless more groves, but I should judge not over 200 acres in all.[1] This is about the extent; but this industry has commenced, and very soon the whole interior will be dotted with forests of the Eucalyptus.

Attempts have been made to introduce the cultivation of various species of this tree in the Southern States, but without encouraging success. It has been found not hardy at Augusta, in Georgia. At Albany, in that State, hopes were entertained that it would be able to survive the winters, but an unusual frost in the winter of 1876–'77 killed it entirely, the temperature having gone down to 14° F.[2]

At New Orleans it has been found too delicate, and, if successful on the Gulf coast, it would probably be in Florida or Southern Texas.

Although of wonderfully rapid growth under a genial climate, it is by no means certain that this timber would prove valuable for construction, or use in the arts, until ripened and hardened by time.[3]

Statistics of Lumber Manufacture in California in 1874, 1875, and 1876, as reported by the Assessors. (*From reports of Surveyor-General.*)

I.—NUMBER OF SAW-MILLS.

Counties.[a]	Steam-power.			Water-power.			Counties.	Steam-power.			Water-power.		
	1874.	1875.	1876.	1874.	1875.	1876.		1874.	1875.	1876.	1874.	1875.	1876.
Alpine	1	1	....	2	....	....	Nevada	18	20	18	9	11	10
Amador	4	4	4	....	....	....	Placer	20	....	17	5	....	1
Butte	17	14	15	4	4	4	Plumas	2	5	4	4	6	5
Calaveras	4	3	1	1	2	2	San Bernardino	5	5	6	....	....	....
Colusa	2	2	2	....	....	....	San Diego	1	6	6	1	1	1
Del Norte	3	3	2	6	4	5	San Luis Obispo	1	1	1	....	1	....
El Dorado	8	11	11	3	3	3	San Mateo	13	14	13	....	....	....
Fresno	6	1	2	....	2	....	Santa Barbara	....	2	....	....	....	....
Humboldt	11	15	18	2	1	2	Santa Clara	3	2	1	2	1	....
Inyo	....	....	....	3	4	4	Santa Cruz	15	15	15	5	5	5
Kern	3	2	3	3	1	1	Shasta	1	2	4	11	10	10
Klamath	2	....	....	8	....	....	Sierra	11	11	10	9	8	8
Lake	7	6	6	2	1	....	Siskiyou	5	3	3	13	13	10
Lassen	2	....	4	3	....	1	Sonoma	14	8	15	....	....	....
Los Angeles	2	3	4	....	....	....	Tehama	7	7	8	2	3	1
Marin	1	1	4	....	....	....	Trinity	1	2	2	2	8	7
Mariposa	2	2	3	....	2	1	Tulare	3	3	3	2	2	1
Mendocino	14	17	16	4	3	3	Tuolumne	4	2	3	1	2	3
Modoc	1	2	1	6	7	8	Yuba	3	3	2	2	2	4
Mono	2	2	1	3	2	3							
Napa	....	1	1	....	....	....	Total	218	202	222	125	111	103

[a] Counties from which no returns were received are omitted from this table.

SACRAMENTO COUNTY.—Two steam-mills, 1874; no product reported.

[1] A recent newspaper article states that the Southern Pacific Railroad Company are preparing to plant 200,000 Eucalyptus trees, in groves, at their several stations in Southern California.

[2] In an article in the First Annual Report of the Board of Health of Georgia, entitled "*Report of Committee on the Influence of Trees on Health*," by Dr. Benjamin M. Cromwell (1875), much confidence was expressed that this tree would grow and thrive in Southern Georgia, but this hope was disappointed by the casualty above noticed. The greatest difficulty had been supposed to occur in getting the plants through the first summer, until their roots penetrated well into the soil, so as to get a full supply of moisture, to resist the evaporation under a hot sun in dry weather. It was hoped that after the first year they would care for themselves, but experience proved that the danger lay in exceptionably cold winters rather than in dry and hot summers.

[3] Baron F. Von Müller, the eminent botanist of Australia, who has done so much toward making known the value of the blue gum, in a lecture delivered at Melbourne, June, 1871, says: "That a period of a quarter or even half a century must elapse before a solid plank, hardened by age, can be obtained from even a rapid-growing Eucalyptus tree. It is estimated to require twenty to twenty-five years before even a sleeper of blue-gum wood can be obtained from a tree planted in ordinary soil; and that double the time will elapse before a sown tree of the still more durable red-gum eucalyptus will furnish sleepers, such as hitherto have been in use for our railroad works. But a supply of fuel from these trees may be obtained much earlier. Mr. Adam Anderson, a timber merchant of this city, concurs in this estimate."

II. PRODUCTION IN SAWED LUMBER AND SHINGLES.

Counties.	Lumber sawed.			Shingles made.		
	1874.	1875.	1876.	1874.	1875.	1876.
	Feet.	*Feet.*	*Feet.*	*M.*	*M.*	*M.*
Alpine	1,000,000	200,000		600,000	10,000	
Amador	3,600,000	5,000,000	3,950,000	514,000	1,400,000	450,000
Butte	62,000,000	45,000,000	47,000,000	1,700,000	1,500,000	1,200,000
Calaveras	2,980,000	2,000,150	1,000,000	4,000,000	4,003,000	3,000,000
Colusa	2,500,000	300,000		250,000	100,000	
Del Norte	8,125,000	7,000,000	10,000,000	50,000	10,000	10,000
El Dorado	1,638,500	6,000,000	4,000,000			
Fresno	3,600,000		1,500,000			
Humboldt	50,000,000	75,000,000	64,000,000	10,000,000	15,000,000	15,000,000
Inyo	962,657	6,098,500	3,888,000	165,000	1,000,000	800,000
Kern	500,000	4,000,000		100,000		
Klamath	2,000,000			1,000,000		
Lake	3,500,000	3,450,000	3,750,000	400,000	300,000	200,000
Lassen	3,000,000		2,000,000	95,000		100,000
Los Angeles	90,000	30,000	60,000			
Marin	600,000					250,000
Mariposa	1,250,000		1,550,000	100,000		
Mendocino	60,000,000	50,000,000	53,000,000	2,500,000	12,000,000	15,000,000
Modoc	3,800,000	2,400,000	3,500,000		150,000	120,000
Mono	10,000,000	1,000,000	250,000	100,000	100,000	
Napa		500,000	700,000			
Nevada	50,000,000	6,000,000	30,000,000	25,000,000	200,000	18,000,000
Placer	21,670,000		25,550,000	2,619,000		2,500,000
Plumas	600,000		3,000,000			
San Bernardino	2,500,000	3,500,000	2,000,000	220,000	300,000	200,000
San Diego	500,000	1,975,000	1,675,130	100,000	75,000	70,000
San Luis Obispo	250,000	200,000	100,000			
San Mateo	6,790,650	6,500,000	5,000,000	32,167,350	41,000,000	37,000,000
Santa Clara	19,137,230	15,197,220	500,000		1,237,000	
Santa Cruz	27,600,000	20,000,000	15,000,000	9,500,000	1,500,000	10,000,000
Shasta	6,000,000	10,450,000	8,100,000	800,000	675,000	800,000
Sierra	6,500,000	3,500,000		200,000	200,000	500,000
Siskiyou	3,500,000	4,000,000	4,000,000	100,000	150,000	200,000
Sonoma	49,874,350	40,000,000	60,000,000	2,615,000	10,000,000	10,000,000
Tehama	10,000,000	95,914,500	34,450,000	2,000,000	200,000	
Trinity	1,400,000	1,800,000	2,000,000			
Tulare	6,300,000	7,400,000	93,000,000	500,000	400,000	22,700
Tuolumne	5,000,000	6,100,000	5,100,000	1,900,000	200,000	300,000
Yuba	3,000,000	2,000,000	1,500,000			500,000
Total	442,018,387	364,044,388	402,963,130	99,505,520	91,730,000	116,228,700

Receipts and exports of lumber at San Francisco in 1877.

A correspondent of the Northwestern Lumberman (February 9, 1878) gives the following amounts as received at that port in 1877, as compared with the two previous years:

Kinds.	1875.	1876.	1877.
Pine.....feet..	163,395,229	161,338,041	159,742,553
Spruce.....do...	13,273,570	16,811,299	9,671,448
Cedar.....do...	7,730,400	10,474,427	5,940,973
Hard wood.....do...	276,750	50,000	67,000
Redwood.....do...	110,309,000	114,199,723	102,698,781
Redwood.....number..	1,763,117	1,536,656	2,198,473
Pickets.....do..	4,085,066	985,000	1,409,318
Ties and poles.....feet..	4,900,000	4,535,150	6,865,000
Sugar pine.....feet..			
Total	303,833,901	309,150,972	288,591,540
Shingles.....M..	104,931,950	114,305,500	99,468,250
Lathe.....M..	58,006,525	62,313,000	43,443,426

The exports by sea were reported as follows:

To what ports or countries.	1875.	1876.	1877.
	Feet.	Feet.	Feet.
Australia	1,088,211	1,611,594	1,670,871
Calcutta	604,470	.....	115,000
Central America	267,641	275,469	293,271
Chili	300,000	769,211	1,770,543
China	1,136,813	146,698	804,005
Ecuador	.....	.....	16,000
England	116,676	230,000	17,704
Fiji Islands	137,000	61,000	.....
Friendly Islands	151,647	.....	.....
Guam	.....	.....	55,469
Honolulu	745,469	1,511,338	1,422,000
Japan	30,000	.....	20,010
Manilla	.....	.....	54,000
Marquesas Islands	43,300	168,985	61,233
Mexico	1,206,241	1,267,320	1,667,227
Navigator's Island	786,797	703,306	937,160
New York	5,000	.....	87,713
New Zealand	7,000	14,037	285,607
Panama	207,669	113,504	177,622
Peru	1,576,775	2,445,652	3,094,756
Russian Asia	105,569	211,755	63,203
Tahiti	1,313,375	1,399,125	1,369,950
Victoria	3,321	7,925	2,675
Total	10,094,189	10,781,220	13,874,207

ALAMEDA COUNTY.—The prevailing winds of this region are northwest. The rains vary greatly—from 7 to 20 inches in a year. The deciduous trees are the soft maple, California walnut, buckeye, cottonwood, willow, white oak, and sycamore. The conifers are cypress, of four species, redwood, Monterey pine, sugar pine, and *Picea amabilis* and *P. grandis*; of broad-leaved evergreens, are laurels of several kinds.

The Eucalyptus, of several species, does well in the valleys and on rocky hills—wherever the scrub oak grows—but will not endure the frost. The fig bears well, but the fruit is not so sweet as it is farther south. It requires a rich and rather moist soil. The orange, lemon, and lime ripen, and are perfectly hardy, their cultivation promising to develop into a large industry. They need water, and protection from chilling winds. The Eucalyptus forms the best wind-break. They are sold at about $6 per thousand, when one foot high. The coffee tree is under experiment, but it is too early to be certain as to the result.

The Japanese persimmon (*Diospyrus kaki*) is becoming a favorite, but has not yet fruited. The cork oak is growing well, but there is not yet much interest taken in it. The hemlock spruce, Norway spruce, and Austrian pine do not thrive, being stunted and miserable in the best soils, evidently from climate. The hickory and hard maple grow very slowly, and the pecan and beech much better. The locust grows, but not as well as in the Eastern States, and is apt to get diseased and to die young.

The woolly aphis is a continual trouble on our grafted apple-trees the second year, but on sandy soil less. Whale-oil soap has been found the best remedy. The stumps and refuse should be burned to get rid of the insects that harbor in them. The oak of this region is liable to attack from a borer. Among fruits, the cherry is most liable to injury by disease and insect ravages. Conifers can only be raised successfully by making seed-beds. They should be about four feet wide, sown in November, covering with sand, and protecting the next summer with laths. Deciduous tree seeds, apples, pears, &c., are sown in depressed beds in March, near a drain-furrow, mulching and watering by filling the beds (which are sunk two inches) with water from a hose when they need soaking. In this climate this treatment just suits them.—(*Chas. H. Shinn*, Niles, Alameda County, California.)

MARIPOSA COUNTY.—In this county occurs the *Yosemite Valley*, of wide notoriety. It comes within our province to notice only so much of this as relates to its forest vegetation, as mentioned in the "Yosemite Book," already quoted.

Along the banks of the river near the falls, there is a dense growth of alders (*Alnus viridis*), which sometimes forms quite a large tree, with ash-colored bark, associated with small trees of the *Rhamnus Mensiesii*, remarkable for its large and somber leaves. A few willows, the Douglas spruce, and, in the upper part of the valley, an occasional sugar pine are also found in this position. Where the valley widens out, and the river banks become lower, so that sloughs and swamps are found, the balm-of-Gilead poplar (*Populus balsamifera*) comes in; this is a common tree in the valley, and is usually mistaken for the cottonwood. With this occurs large willows, an abundance of the Douglas spruce, and also the *Azalea occidentalis*, whose superb white and fragrant flowers form one of the charms of the valley.

The sandy region makes up the largest portion of the valley above Indian Cañon, has been evidently formed by the washing down of the finer portions of the *débris* from the walls, and is peculiarly the arboriferous belt of the valley. On the drier and looser portions the pitch or yellow pine (*P. ponderosa*) and the bastard cedar (*Libocedrus decurrens*) are the most abundant and characteristic trees, both occurring of considerable size and fine proportions, the pines being usually from 125 to 150 feet high. Below the Bridal veil Fall, near the *débris*, the fir (*Picea grandis*), a noble tree, comes in; near the swampy land the black oak (*Q. Sonomensis*) is abundant. The sandy region also bears a great number and variety of shrubs and undergrowth; among these are the *Cerasus Nuttallii*, with its showy white flowers, 3 inches in diameter; *Rubus Nuttanus*, the most beautiful of the raspberries, and found from Lake Superior west; also the characteristic California shrub, manzanita (*Arctostaphylus glauca*). The most characteristic tree of the *débris* piles is, perhaps, the mountain live oak (*Q. chrysolepis*, Lieb), which is associated in the higher portions with the common, shrubby, evergreen oak of the higher Sierras, perhaps the *Q. vaccinifolia* of Kellogg. In the vicinity of the points where small streams come over the precipices we find the Oregon maple (*Acer macrophyllum*), with its large and deeply-cut leaves, and, in the higher portions of the *débris*, another maple (*A. glaucum*), a shrub 10 to 15 feet high, whose delicate branches, long pedunculated leaves, and clusters of reddish seed, make it an object conspicuous for its beauty. Near the base of the *débris*, where the streams of the smaller waterfalls emerge, the California laurel (*Tæniathera Californica*) occurs as a small tree, with smooth, brilliant, evergreen foliage, and aromatic odor.

NEVADA COUNTY.—Truckee, near the eastern border of this State, is the most important point for the manufacture of lumber and supply of mining timbers among the Sierras, and is one of the chief points for supplying Virginia City, Nev. There are in this vicinity several flumes for bringing timber down from the mountains, where it would be otherwise difficult of access. We have no statistics of the production of this region.

SAN DIEGO COUNTY.—A correspondent of the Ohio State Journal, writing September, 1875, from San Diego, Cal., says that within a radius of a mile of the court-house there were 4,759 shade and ornamental trees, not including fruit and nut trees; and that there were in the county 37,749 trees, all planted within six years. Among the kinds growing were the cork tree, date palm, India rubber, magnolia, Monterey cypress, Norfolk Island pine, Mexican pepper, and *Eucalyptus globulus*. The latter had grown 10 to 15 and even 20 feet in a single season. A tree planted from seed in January, 1870, measured 42 inches around at the base, and 32 inches at 6 feet from the ground. It was estimated as 60 feet high.

OREGON.

Prof. James D. Dana, in an article upon the physical geography of Oregon and Upper California,[1] before much settlement began, remarks that in the vicinity of the sea the country instead of being open prairie is covered with forests of evergreens:

> In Oregon these prevail over the larger part of a breadth of 30 miles along the coast. In the vicinity of Astoria, as has been mentioned by various travelers, the trees of the dense woods are extremely large, 250 to 300 feet being a common height. In July, 1841, on an excursion to Mount Swalalahs, 25 miles south of Astoria, we traveled over a heavily timbered undulating country, passing trees occasionally 25 feet in circumference; and one measured was 37 feet. In some places the fallen trunks of trees (pines, hemlock, spruce, and alders) so obstructed the way that we were compelled to travel upon them, passing from one to another, seeing the ground 10 or 15 feet below us. The soil was generally good, and supported a thick growth of underbrush. There were flats near Chisheck's River, but they were covered with forests.
>
> The country of the western section is thus divided longitudinally into a forest and prairie portion, the former densely wooded, the latter having only scattered oaks and lines of forest along the streams. Yet in these prairie districts, elevations over 1,000 feet high are wooded like the coast region, and the forests extend down their slopes, especially the northern and western, nearly or quite to their bases. Elk Mountain and the Umqua Ridges are thus densely covered with forests.[2]

Such was the primative aspect of the native forests of this State. We have given on a preceding page, in connection with our account of California, Professor Newberry's statement, from more particular examination made many years later.[1] The amount of foreign exportation will be presented fully in the statistical portion of the report. The coastwise trade is largely to the San Francisco market; but the amounts from this State cannot well be separated in these returns from those of Washington Territory.

A business article on the lumber trade of the Pacific Coast, published at San Francisco in July, 1877, states that the lumber shipped to that place from Puget Sound consists in the main of Oregon pine, with much spruce, rough and dressed, some cedar and some maple. The redwood comes from California ports. The ports then principally shipping to San Francisco were Crescent City, Coos Bay, the Columbia River, and along up the Coast to Victoria. The increase in the amount received at San Francisco had been as follows:

In 1874.—139,856,486 feet of Oregon pine, 11,866,163 feet of rough spruce, 765,690 feet of dressed spruce, 3,144,343 feet of rough cedar, 188,856 feet of maple, 1,019, 646 feed of redwood, 10,000,000 (nearly) of rough sugar-pine pickets, railroad-ties, telegraph-poles, &c.

In 1875.—163,695,426 feet of Oregon pine. Total increase over 1874, about 53,073,634 feet.

In 1876.—309,159,972 feet received of all kinds.

The carrying trade in lumber on the coast required a capital of about $12,000,000 annually, and employed a fleet of 123 sailing craft, chiefly schooners and sloops.

WASHINGTON TERRITORY.

A correspondent of the Northwestern Lumberman, (March 17, 1877,) in speaking of the timber resources of Oregon and Washington Territory, says that four fifths of the area, embracing the eastern part, is an agricultural region, the fir timber being limited to the mountain ranges, chiefly along the coast and on the streams tributary to the sound. He says:

> Perhaps the size of some of the trees has been overstated. Perhaps also, the yield per acre for a limited area has not been exaggerated, but the error lies in the supposition that those immense trees are the ordinary growth, and the marvelous yields the average production of the whole Territory. The timber belt on Puget Sound, is about 170 miles long and 30 wide, and of this not more than one third is timbered with fir, there being scarcely any pine in Washington, though the fir is a species of pine. The rest of the timber is hemlock, vine and soft maple, alder, and cedar. The latter is interspersed with the fir, and will in time become valuable, though at present it has little commercial value on the sound. On the highlands the cedar attains a remarkable growth, and is smooth and straight-grained. I saw one tree recently that measured 63 feet in girth; while 190 feet high is no unusual growth. The area of pine, or fir, is then about 1,700 sections, or 47 townships.

Estimating the yield at 25 M feet per acre as a fair average, the Puget Sound timber region would yield 27,200,000,000 feet of fir, or about equal to the best estimates of standing timber in the lower peninsular of Michigan. Two grades of timber are known in the trade as *sap* and *overgrown*, the former yielding some 7 M feet to the tree, (sometimes not over 2 M), and the latter from 8 to 15 M. The sap fir does not grow as high as the other, which runs to 120 feet without a limb, and sometimes 160 feet. With regard to future lumbering operations, the writer, un-

[1] This account by Professor Newberry was prepared in 1854–'55, in connection with Pacific Railroad surveys.

der notice, remarks, that each successive winter drives the camps further back and up the streams, which has led to a careful investigation of the facilities for floating the logs to the mills, and here is found about the only dark prospect for lumber operations in the Territory. There are but five streams on the south of the Sound in a distance of ninety miles, on an average distance of eighteen miles, the smaller streams not being available, being mountain torrents or rills.

The amount of lumber products shipped from Puget Sound and Oregon to San Francisco, in 1876, amounted to 125,258,520 feet of rough pine; 22,399,121 of dressed; 13,307,703 of pine fencing; and 372,197 pickets. A considerable business was done in spruce, and 474,424 feet of cedar were delivered. The red-wood trade amounted to 120,000,000 feet, and hard wood to 50,000 feet.

The Pacific coast of South America is almost wholly dependent upon our supplies in Washington and Oregon for the timber and lumber used in building. In 1869, they were drawing heavily upon these resources to rebuild the wharves and public works destroyed by earthquakes the year before.[1] England, France, Australia, China, Japan, Mexico, and the Sandwich Islands have also been and still are drawing heavily upon that region for timber supplies.

ALASKA.

Conflicting accounts of the forest resources of this region have been published, some attributing to it extensive and valuable forests of easy access, while others deny that there are any considerable supplies of timber in the immediate vicinity of the coast and in the southern part. A "*Sketch of the Flora of Alaska*," by Prof. J. T. Rothrock, presents a statement drawn from many sources concerning the vegetation of this region, which, if it does not afford statistical estimates of the amount, gives at least some idea of variety of forest trees in this region.

Of the CONIFERÆ eight species are mentioned: the *Abies Canadensis*, *A. Mertensiana*, *A. Sitchensis*, *A. alba*, *Pinus Cembra*, *P. contorta*, *Thuja excelsa*, and *Juniperus nana*. Of the BETULACEÆ there are six species: *Betula glandulosa*, *B. nana*, *B. Ermanii*, *Alnus viridis*, *A. rubua*, and *A. incana*. The SALICACEÆ are represented by 18 species, all willows, excepting one poplar, the *Populus balsamifera*.

The *Rosaceæ*, embracing 29 species, the CORNACEÆ 4, the CAPRIFOLIACEÆ 4, and MYRTACEÆ 1, are represented by some woody plants and shrubs, but none of them that are of importance in forestry. At the head of Norton Sound a forest of spruce extends nearly to the coast, and occasionally trees are seen on the immediate shore. They are usually from 20 to 45 feet in height, and not more than 1 foot in diameter. Trees 80 to 100 feet occur at the lower Kvichpak, and a little lumber has been sawn at Fort Saint Michaels. The *Abies Douglasii*, *A. Menziesii*, *A. Thuja gigantea*, and *Acer macrophyllum* occur in British Columbia, and doubtless extend into southern Alaska.

About the beginning of the present century, a few Sitka spruces were planted on an island in Iliuliuk Harbor, Unalashka, and in seventy years have become nearly a foot in diameter. Some thirty years later, a few more were planted on another small island in the same harbor, but with poor success. With these feeble exceptions, there has been, it is believed, no attempt at planting in any part of Alaska.

[1] *Transactions of California*, State Agricultural Society, 1868–'69, p. 29.
[2] *Annual Report of Smithsonian Institution* 1876, p. 433.